

# The failed back syndrome: the diagnostic contribution of computed tomography

C S McKinstry, Kathleen E Bell

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Up to 30% of patients who undergo surgery for lumbar disc disease experience recurrent symptoms postoperatively.<sup>1,2</sup> This so-called 'failed back syndrome' is a complex phenomenon influenced by organic, psychological, economic and social factors.<sup>3,4</sup> Radiological examination is frequently requested in order to exclude an anatomical basis for the patient's complaints<sup>3</sup> (Table I). Re-exploration in the presence of significant epidural scarring (fibrosis) from previous surgery may lead to further more severe scarring,<sup>5</sup> although some surgeons may consider microsurgical lysis of scar tissue (DP Byrnes, personal communication). Neural compression due to recurrent disc protrusion or canal or lateral recess stenosis may be relieved surgically.<sup>1,6</sup> Accurate radiological diagnosis of these and other possible abnormalities is therefore of paramount importance,<sup>1,7</sup> especially in view of the difficulties in performing re-exploration of the lumbar spine.

TABLE I

*Possible causes of the failed back syndrome*

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Epidural scar
Recurrent disc prolapse
Spinal or lateral recess stenosis
Arachnoiditis
Discitis
Facet joint arthropathy
Painful disc degeneration without rupture
Spondylolisthesis
Pseudomeningocele

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Myelographic appearances following surgery are non-specific, and in addition, myelography is insensitive to the effects of unsuspected bony changes, such as lateral recess stenosis.<sup>3,8</sup> Experience with high resolution computed tomography (CT) has led to its preference in the radiological investigation of the failed back syndrome.<sup>9</sup> Use of intravenous radiological contrast media has been reported further to improve accuracy.<sup>7,10-15</sup> In this report we describe our experience with CT scanning in 100 consecutive patients with the failed back syndrome.

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Department of Neuroradiology, Royal Victoria Hospital, Belfast BT12 6BA.

C S McKinstry, FRCR, Consultant Neuroradiologist.

Kathleen E Bell, FRCR, Consultant Neuroradiologist.

Correspondence to Dr McKinstry.

## MATERIALS AND METHODS

Between October 1987 and December 1989 102 consecutive CT scans were performed on 100 patients at 131 disc levels where surgery had been carried out. The initial operation had been for disc prolapse on 125 occasions and at six levels laminectomy had been performed for spinal stenosis. The patients were aged between 19 and 68 years, and scans were performed between six months and 13 years after the previous surgery, except in two cases scanned within two weeks of operation. The scans were performed on a Siemens Somatom DR3 scanner. Contiguous slices 4 mm thick were obtained from the pedicle above to the pedicle below each disc space, angled parallel to the disc itself. All three lower lumbar discs were included regardless of the level of previous surgery. At 86 levels, scans were repeated following an intravenous bolus of 100 ml contrast medium containing 300 mg/ml iodine (Niopam 300, E Merck Ltd).

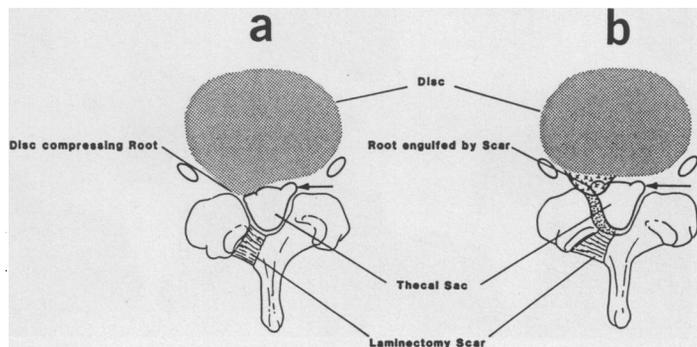
The CT scans were analysed for the presence of any significant abnormality involving the nerve roots or spinal canal. Where a soft tissue mass was seen at the disc margin with possible compromise of the adjacent root, differentiation of recurrent disc herniation from scar tissue was based on published criteria<sup>9</sup> (Table II, Fig 1). Scans were also classified as showing a mixture of disc fragment and scar tissue, or as indeterminate.

Scans were classified as showing scar posteriorly at the laminectomy site or in the adjacent posterolateral spinal canal (not involving a nerve root) only if no other clinically significant abnormality was present. The CT density of any abnormal tissue was measured using a computer generated region-of-interest facility on the scanner video monitor.

TABLE II  
*Differentiating features of scar tissue and recurrent disc on CT*

<i>CT feature</i>	<i>Scar</i>	<i>Recurrent disc</i>
Site	May be above or below disc space and may be continuous with posterior scar	Usually contiguous with disc margin
Shape	Typically follows contour of thecal sac and may cause retraction of it	Mass which indents thecal sac and displaces nerve root
Density	< 50 CT units	> 65 CT units
Enhancement	Usually present	Absent

Fig 1. Diagrammatic representation of recurrent disc protrusion (a) and pure postoperative epidural fibrosis (b). Arrow = normal nerve root emerging from thecal sac. Note scar tissue engulfing root on side of previous surgery in (b) (cross-hatching), also scar extending along margin of thecal sac (stippled area).



Changes in abnormal tissue following intravenous contrast were assessed subjectively and objectively using the region-of-interest facility. The phenomenon of 'enhancement' of tissue on CT following intravenous contrast medium depends to a large extent on the vascularity of the tissue, and also on its tendency to accumulate the medium.<sup>16</sup> In theory, such media should enter vascular scar tissue causing a rise in CT density (enhancement), whereas avascular disc material should show no change. Definite enhancement was diagnosed when the CT density rose by at least 10 units following contrast administration. Clinical follow-up was obtained in all patients and where subsequent re-exploration was carried out, the surgical findings were compared with the CT diagnosis.

## RESULTS

CT diagnoses at the 131 previously explored disc levels are shown in Table III, and illustrated in Figs 2–6.

TABLE III  
*CT diagnoses at previously explored disc levels*

<i>Diagnosis</i>	<i>Number (%)</i>
Recurrent disc protrusion (Fig 2)	18 (14%)
Fibrosis: — at disc margin (Fig 3)	29 (22%)
— posteriorly	43 (33%)
Disc fragment and fibrosis (Fig 4)	16 (22%)
Spinal or lateral recess stenosis (Fig 5)	10 (8%)
Other (Fig 6)	8 (6%)
Disc bulge only	3
Facet arthropathy	2
Spondylolisthesis	1
Discitis	1
Equivocal	7 (5%)
<b>Total</b>	<b>131</b>

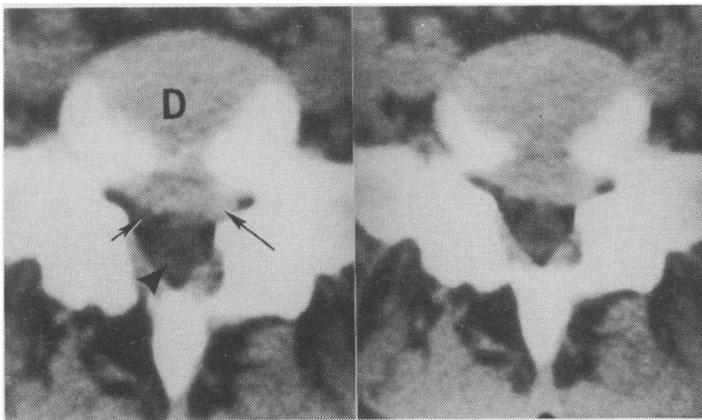


Fig 2 (a) and (b).  
Recurrent disc protrusion. CT scans before (a) and after (b) intravenous contrast. Non-enhancing disc material displaces adjacent root (long arrow): compare normal root on opposite side (short arrow). Arrowhead = thecal sac.

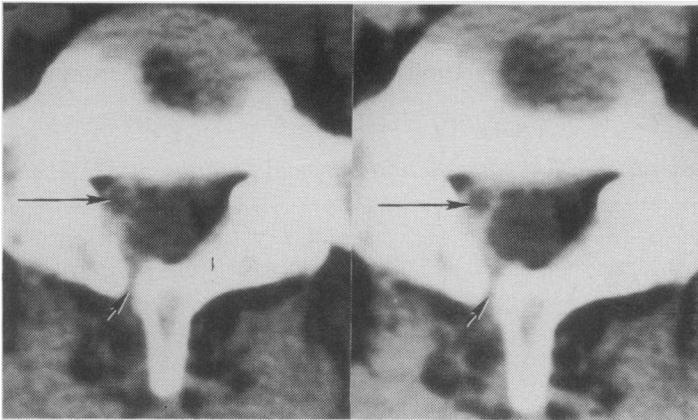


Fig 3 (a) and (b). Pure epidural fibrosis. CT scans before (a) and after (b) intravenous contrast. Non-enhancing nerve root (long arrow) is surrounded by enhancing fibrosis. Note enhancing tissue extending along margin of thecal sac to laminectomy scar (short arrow).

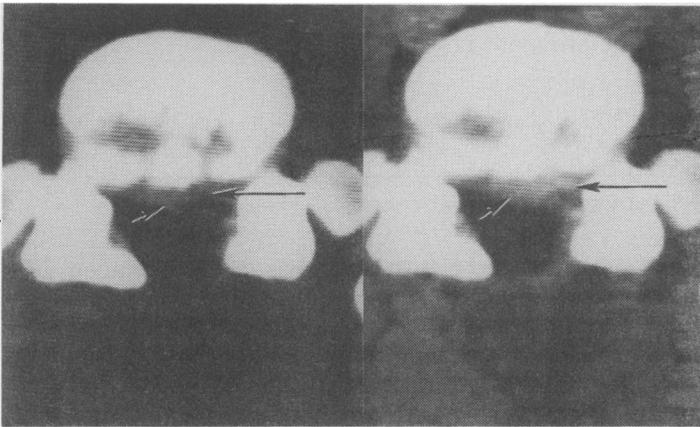


Fig 4 (a) and (b). Mixed recurrent disc protrusion and epidural fibrosis. CT scans before (a) and after (b) intravenous contrast. Non-enhancing disc material indents thecal sac (short arrow); enhancing fibrosis is seen laterally around nerve root (long arrow).

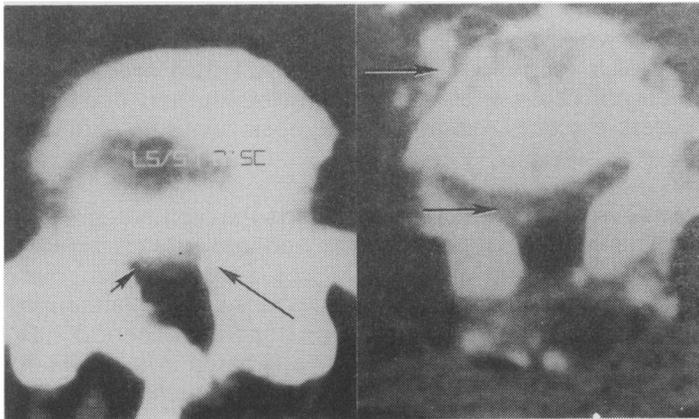


Fig 5 (left). Lateral recess stenosis. CT scan shows massive hypertrophy of the right interfacetal joint with encroachment on the lateral recess and nerve root (long arrow). Compare normal side (short arrow).

Fig 6 (right). Postoperative infective discitis. CT scan shows abnormal soft tissue and multiple fragments of bone around the margins of the narrowed disc space (arrows).

In 34 patients, subsequent re-exploration was carried out at 36 levels. The results of both the unenhanced and enhanced scans at these levels were compared with the surgical findings in order to assess the contribution of intravenous contrast to the accuracy of CT (Table IV).

TABLE IV

*Re-exploration: comparison of CT diagnosis and surgical findings at 36 levels*

	CT diagnosis	Confirmed at surgery
<i>Unenhanced CT scan</i>		
Recurrent disc prolapse	8	6
Epidural fibrosis	10	8
Spinal or lateral recess stenosis	1	1
Bone fragment	1	1
Disc bulge only	1	1
<i>Enhanced CT scan (indeterminate on unenhanced scan)</i>		
Epidural fibrosis	6	4
Disc fragment and fibrosis	5	5
Indeterminate	3	*

\*All 3 of these levels were found at surgery to have disc fragments and fibrosis.

Use of intravenous contrast never altered a firm diagnosis on unenhanced CT, which was correct at 17 out of 21 levels. There were two false positives for disc recurrence. At one level, an epidural vein was found at surgery, but due to patient discomfort a delay occurred between contrast administration and repeat scanning which may have been responsible for the apparent non-enhancement in this case; at the other level, suspected recess stenosis was confirmed but the presumed disc recurrence was not. In two cases of presumed epidural fibrosis on CT, small disc fragments were found embedded in scar tissue. In one case a recurrent disc protrusion was correctly diagnosed, but a pseudomeningocele was missed.

Fifteen levels were indeterminate on unenhanced scans. One patient had magnetic resonance imaging (MRI) instead of enhanced CT. In the other 14, enhanced CT gave a correct diagnosis at nine out of 11 levels, with three remaining indeterminate. At two levels where CT predicted pure epidural scar, small disc fragments were also found at re-exploration. CT also predicted a further significant abnormality at 12 levels at which no previous surgery had been performed. Five of these were explored and the CT diagnosis confirmed at four.

## DISCUSSION

Our experience with CT scanning confirms previous reports that some degree of epidural scarring occurs in the majority of patients who undergo surgical exploration of the lumbar spine.<sup>7, 9, 17, 18</sup> In contrast, the incidence of true recurrent disc herniation is low.<sup>7, 9</sup> The exact mechanism of scar formation is unclear, although scanning of asymptomatic volunteers in the early postoperative period has suggested that it may be linked to the soft tissue swelling and haemorrhage which occur acutely in most cases.<sup>17, 19</sup> Although microsurgical techniques have been

advocated as a method of reducing the incidence of postoperative epidural scarring,<sup>20</sup> no direct correlation of CT findings with the type of surgery has yet been demonstrated.<sup>12</sup>

Where epidural scarring is confined to the laminectomy site and/or the lateral spinal canal, it is probably of no clinical significance, and no diagnostic difficulty should be encountered on CT scanning.<sup>9</sup> However, where a soft tissue mass is seen adjacent to the disc margin, differentiation from recurrent disc herniation must be made. Teplick and Haskin in 1983 based this on the known appearances of virgin disc prolapse on CT.<sup>9</sup> Disc material was characteristically high in density, and indented adjacent structures, whereas scar tissue was usually low in density and caused retraction of adjacent structures. However, several authors also described "mass-like" scars which could simulate disc material,<sup>10-12</sup> and in addition the accuracy of CT density measurements in the postoperative spine was questioned.<sup>13, 16</sup> Use of intravenous contrast to improve diagnosis was first described in 1982,<sup>10</sup> the assumption being that contrast medium administered intravenously should not enter avascular disc material but would enter the highly vascularised scar tissue, which would therefore show enhancement on CT. Many papers followed confirming this experience and recommending contrast, usually at high dose, in all cases where a possible disc recurrence was seen.<sup>12-14, 21</sup>

Dixon subsequently reported that use of intravenous contrast did not alter a firm diagnosis of disc or scar on unenhanced CT.<sup>22</sup> He suggested its use only in those cases where unenhanced CT was equivocal, and also questioned the need for very high doses of contrast. Our experience is similar; use of contrast never altered a firm diagnosis on unenhanced CT, and we also routinely were able to identify enhancement using a moderate dose of contrast. Reserving contrast for use in indeterminate cases reduces costs and avoids the morbidity associated with its use. Retrospective review of our case material has led to a more selective use of contrast in our department.

Our accuracy rate for distinguishing disc from scar was 72% at 32 levels (excluding the patient who had MRI instead of enhanced CT). To our knowledge, this represents the largest reported series of surgically confirmed cases. Other authors have reported an accuracy of 74% (23 cases),<sup>13</sup> 67% (number unspecified)<sup>15</sup> and 100% (13 cases of disc prolapse only).<sup>21</sup> In all other series the number with surgical confirmation has been ten or less. This compares with an accuracy rate for CT and magnetic resonance imaging in virgin disc prolapse of 72-97%.<sup>23</sup>

The most difficult scans to interpret are those in which the appearances are not absolutely characteristic of scar or disc material. Typically these are cases in which a soft tissue mass is seen adjacent to the disc which is intermediate in density between scar and disc, which does not cause marked indentation of the thecal sac, and which enhances unhomogeneously. The differential diagnosis is then between nerve root surrounded by scar tissue and a disc fragment embedded in scar. It has been suggested that this is usually not difficult,<sup>11, 12</sup> but we agree with others that this distinction sometimes cannot be made reliably and that the radiological report should state that this is so.<sup>13, 14</sup> Failure to detect such fragments within scar was responsible for four of our incorrect diagnoses on CT, and inability to exclude their presence was responsible for our indeterminate scans. However, CT was always correct in predicting the presence of significant scar, whether or not a small disc fragment was also present. There were no false negatives for "true" recurrent disc and only two false positives.

Earlier reports indicated that unsuspected spinal canal or lateral recess stenosis were common causes of the failed back syndrome,<sup>1</sup> but our series agrees with more recent reports that such abnormalities are found infrequently.<sup>9,24</sup> This may be related to the widespread adoption of CT as the primary radiological investigation for lumbar disc disease, as lateral recess stenosis is more accurately demonstrated by this method than by myelography. Accurate demonstration of facet joint pathology is a further advantage of CT. The severity of disease may be a guide to the likely outcome from facet anaesthesia in patients with appropriate symptomatology.<sup>25, 26</sup> Other causes of failed back syndrome are rarely seen. Conflicting reports have appeared concerning the value of CT in early discitis. Reliable diagnosis is probably only possible when frank infection with soft tissue swelling and vertebral end plate destruction are present as in our case. CT appears to be as sensitive as plain films and radionuclide scanning in such cases, but magnetic resonance imaging may be more sensitive in so-called "aseptic" discitis.<sup>27</sup> Pseudomeningocele due to dural tear at surgery is also a rare finding and in retrospect should have been suspected from the CT scan in our case. Myelography was diagnostic but would have been required in any case for planning of surgery; it should be noted that not all pseudomeningoceles will fill with myelographic contrast material.<sup>9</sup>

Although we found a low incidence of pathology at levels not previously explored, we continue to scan all three lower lumbar discs routinely in view of the risk of missing a lesion not demonstrated on previous radiological studies. A particular consideration would be an unsuspected far lateral disc protrusion, where only myelography was previously performed.<sup>28</sup> Although we advocate CT as the preferred investigation, there is no doubt that myelography still has a place. It remains the only reliable method of diagnosing arachnoiditis,<sup>8</sup> although CT and MRI changes have been described.<sup>12, 29</sup> Myelography also allows a more dynamic study of the lumbar spine which may be important in cases of suspected spinal instability and in spondylolisthesis. CT has been combined with myelography but to no definite advantage.<sup>7, 8</sup>

Recent reports comparing MRI with CT have indicated its superiority in differentiating scar and recurrent disc, especially when gadolinium-DTPA enhancement is used.<sup>24, 30</sup> MRI also detects the early changes of disc degeneration without rupture,<sup>31</sup> although discography may still be required as a diagnostic provocative test.<sup>32, 33</sup> The availability of MRI is likely to remain restricted and in addition CT remains better for demonstrating bony changes including the facet joints and lateral recesses.<sup>32</sup> Our current practice is to refer for MRI only those patients in whom CT is negative or equivocal.

The surgical decision to re-explore must only be based on the radiological findings in conjunction with the history and physical signs. With careful selection, the results of re-exploration can be rewarding,<sup>6</sup> and CT with the selective use of intravenous contrast offers an accurate non-invasive method of helping to make this difficult decision.

We wish to thank our neurosurgical and orthopaedic colleagues for referring patients to us and for providing details of their operative findings. Figure 1 was prepared by Mr Brendan Ellis of the Department of Medical Illustration.

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